

TECHNICAL SPECIFICATION

PRECOMMISSIONING OF PIPELINES

DEP 31.40.50.30-Gen.

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DESIGN AND ENGINEERING PRACTICE

USED BY
COMPANIES OF THE ROYAL DUTCH/SHELL GROUP



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All administrative queries should be directed to the DEP Administrator in SIOP.

NOTE: In addition to DEP publications there are Standard Specifications and Draft DEPs for Development (DDD's). DDD's generally introduce new procedures or techniques that will probably need updating as further experience develops during their use. The above requirements for distribution and use of DEPs are also applicable to Standard Specifications and DDD's. Standard Specifications and DDD's will gradually be replaced by DEPs.

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1. INTRODUCTION

1.1 SCOPE

This new DEP gives minimum requirements for dewatering, cleaning, drying and preservation of pipelines. These activities are termed precommissioning and may be necessary to prevent unacceptable internal corrosion and fluid contamination during commissioning and operation of the pipeline.

The requirements for preparing the precommissioning work, the health, safety and environmental precautions, and the equipment and media are also included in this DEP.

This DEP should be used as a technical specification to be incorporated into a precommissioning or construction contract. The Principal shall provide in the scope of work the relevant pipeline and hydrotest water data and define the activities to be performed, media to be used and other requirements as stated in this DEP.

This DEP is applicable for onshore and offshore carbon steel pipelines, flowcoated and non-flowcoated, and GRE/GRP pipelines which passed the hydrostatic pressure test and are filled with the hydrotest water. Appendix A specifies the additional requirements for stainless steel pipelines and pipelines with internal stainless steel cladding.

This DEP is not applicable to commissioning activities.

- NOTES:
- 1) Activities requiring the introduction of fluid to be conveyed into the pipeline become part of commissioning. Relevant requirements of this DEP may be incorporated in the commissioning procedure.
 - 2) Methanol swabbing shall only be performed with the final product as a driving medium.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIPM, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors nominated by them (i.e. the distribution code is "C", as defined in DEP 00.00.05.05-Gen.).

This DEP is intended for use by Functions in the Group that are involved in precommissioning of pipelines.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, installation and commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant, authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

block valve	Valve for interrupting the flow or shutting-in a section of a pipeline. A block valve is normally either fully open or fully closed.
commissioning	An activity where the fluid to be transported is initially introduced into the pipeline.
equipment	All temporary fittings, piping, pumps, compressors, pigs, materials, equipment and consumables used for precommissioning of the pipeline.
fluid	The fluid(s) to be conveyed in the pipeline during operation.
"golden weld"	A weld which is not subject to a hydrostatic pressure test and as such must pass additional non-destructive inspection.
hydrostatic pressure test	That part of the testing operations where the pipeline is pressurised. The hydrostatic pressure test includes a strength test and a leak tightness test.
key personnel	The personnel appointed and specially named by the Contractor to be in full charge of all precommissioning operations to be performed.
pipeline	A section of a system of pipes and other components or the entire system used for the transport of fluids, between plants. A pipeline extends from pig trap to pig trap (including the pig traps), or, if no pig trap is fitted, to the first isolation valve within the plant.
precommissioning	A series of activities, that can include fresh water swabbing, dewatering, final cleaning and drying to prepare the pipeline internally for commissioning.
precommissioning plan	The Contractor's plan for the preparation and execution of precommissioning activities including the equipment to be used.
scope of work	The part of the contract which states the overall scope for precommissioning operations.
sleeping pig	Pig present in the pipeline at the commencement of precommissioning.

1.4 ABBREVIATIONS

GRP/GRE	Glass-fibre Reinforced Plastics / Glass-fibre Reinforced Epoxy
ID	Inside Diameter
MAOP	Maximum Allowable Operating Pressure
OD	Outside Diameter

1.5 ACTION ITEMS

An (S) in the margin indicates that the Principal is required to select the method, specify the medium, to make a decision or to give a particular specification, value or parameter.

NOTE: A summary check-list of these items to be specified in the scope of work is given in (10). Where the Principal's decision is only required under certain circumstances, this is not shown by a margin marker.

An (A) in the margin indicates that the Contractor is required to obtain the Principal's approval for a particular action or procedure.

NOTE: It is intended that most, if not all, of these approvals would be part of the precommissioning plan

which is required to be approved by the Principal prior to the commencement of the precommissioning operations. The subjects to be part of the precommissioning plan including the requirements of supervising personnel are given in (2.2). A summary listing of the required additional approvals is given in (11). It is assumed that the Contractor's quality systems and procedural details will have been screened prior to contract award and that the referenced approvals merely need finalising and/or formalising.

1.6 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced by this DEP are listed in (12).

2. GENERAL REQUIREMENTS

2.1 BASIC REQUIREMENTS

- (S) The Contractor shall perform the precommissioning in accordance with the requirements of the scope of work and this DEP. The requirements of the scope of work shall take precedence in case of conflict(s) between the requirements this DEP and the scope of work. Precommissioning should commence either immediately after completion of the hydrostatic pressure test or immediately prior to commissioning as specified in the scope of work.
- (S) Precommissioning activities shall be executed in the sequence defined in the flowchart in Figure 1 unless otherwise specified in the scope of work.
- (S) The following general information shall be provided in the scope of work:
 - all relevant pipeline data;
 - hydrotest water quality;
 - the existing hazardous area classifications of the proposed work sites.

Hydrotest water and all water required for the precommissioning shall be disposed of and supplied in accordance with DEP 31.40.40.38-Gen.

NOTE: DEP 31.40.40.38-Gen. also specifies the requirements for water filtration and treatment.

Media other than water which will be introduced into the pipeline for precommissioning shall meet the following requirements:

- they shall be clean and free of oil;
- nitrogen, methanol and glycol shall have a purity of at least 99%;
- the temperature of the media when entering the pipeline shall not be less than 0 °C or the minimum pipeline design temperature, whichever is the highest, and not more than 50 °C or the maximum pipeline design temperature, whichever is the lowest.

All measurements, calculations and reporting shall be in SI units. Pressures shall be quoted in bar (ga) except for vacuum pressures which shall be stated in bar (abs).

2.2 PRECOMMISSIONING PLAN

- (A) The Contractor shall execute the work in accordance with the precommissioning plan approved by the Principal before commencement of the precommissioning at the work site(s).
- (S) The Contractor shall prepare the precommissioning plan for submission to the Principal for approval not later than 4 weeks before commencement of the precommissioning at the work sites unless otherwise specified in the scope of work.

The precommissioning plan shall include as a minimum:

- a) an outline description of the required precommissioning work including sequence of activities and programme. The programme should include for the individual activities, the start and completion dates, and the dates for mobilisation and demobilisation of equipment, personnel and supplies to the work sites;
- b) the Contractor's organisation chart for the work with a description of the responsibilities for the key personnel;
- c) scope(s) and name(s) of subcontractor(s) and supplier(s) and the method of management of these by the Contractor;
- d) description of the interface(s) and line(s) of communication with the Principal;
- e) identification of all potential health, safety and environmental hazards with a description of the contingency procedures and an emergency plan (3);
- f) a procedure for each main activity covering:
 - a step by step description of the work;
 - description of the required personnel, equipment and consumables, certification, monitoring, records and verifications;
 - location and layouts with hazardous area classifications for equipment and supplies, including water supply and disposal facilities;
 - calculations and any other evidence necessary to demonstrate that the work will be

- executed in accordance with the requirements of the Principal;
- g) contingency procedure(s) for the removal of stuck pigs;
- h) the "Table of Contents" for the "Final Precommissioning Report" (2.4) with sample copies of Contractor's standard forms and sheets.

2.3 CHECKS AND COMPLIANCE

The Contractor shall verify throughout that all the work is executed in full compliance with all the requirements of the scope of work and this DEP. Verifications shall, as a minimum, include:

- a) availability of the approved precommissioning plan at the work site(s) before commencement and during the work;
- b) identification, certification and condition of equipment and supplies to be provided in good serviceable condition, clearly identified with current certification prior to mobilisation, immediately upon arrival at the work site(s) and throughout the precommissioning;
- c) positioning of necessary warning notices, marker tapes, protective barriers, safety and fire fighting equipment;
- d) compliance with the hazardous area requirements;
- e) installation, earthing and protection of equipment;
- f) compliance with safe storage requirements of chemicals;
- g) instruction of personnel on their responsibilities and task(s) and possible hazards with the necessary safety measures;
- h) availability and functioning of safety and communication equipment, including backup equipment;
- i) availability of required permits and adherence to their requirements.

2.4 PRECOMMISSIONING RECORDS AND REPORTS

The Contractor shall take the records specified in the scope of work and this DEP and maintain these records for inclusion in the "Final Precommissioning Report". All record charts shall be signed by the Contractor immediately before placement in the recorder and when taken from the recorder.

The Contractor shall prepare a "Final Precommissioning Report" which shall include as a minimum:

- overall debrief of the precommissioning work;
 - analysis of performance against the precommissioning plan;
 - records specified in this DEP.
- (A) The first draft of the report shall be submitted for approval to the Principal within 14 days following the completion of the work at the work site(s). In the event of comments by the Principal, the Contractor shall update the report within 14 days.
- (S) The Contractor shall issue one final report with all original records/documents and three copies (or more if specified in the scope of work) within 14 days of approval of the draft report by the Principal.

3. HEALTH, SAFETY AND ENVIRONMENT

- (S) The Contractor shall, in the precommissioning plan, identify the hazards associated with the precommissioning activities and work site(s) including those advised by the Principal and shall define the necessary measures.

- (S) The Contractor shall provide gas detection devices and/or breathing apparatus when required for safe working practices and when specified in the scope of work.

Equipment should be installed at locations away from public places, roads or living quarters. Contractor shall control the access to and activities at these locations.

The Contractor shall place warning signs and notices, such as 'KEEP AWAY - PIPELINE UNDER PRESSURE' or 'KEEP AWAY - PIPELINE UNDER VACUUM', at appropriate places such as affected pipework, isolation valves in branches and main line block valve stations. Notices shall be in English and the local or working languages.

The Contractor shall provide radio or other means for dedicated communication between locations where precommissioning work is being carried out or that are affected.

The Contractor shall ensure that the hazards associated with the use of nitrogen and the safety precautions to protect personnel are known, understood and applied by all personnel carrying out the work.

Material safety data sheets shall be available at the site where chemicals are stored or handled. Chemicals shall be stored, handled, used, recycled and disposed in accordance with the recommendations of the supplier and other applicable requirements. Chemicals should be stored in properly marked original packings, in small quantities and away from sources of heat and fire. Contractor shall inform all personnel at the work sites of the hazards and provide the necessary training and protective means.

Soil and water contamination from spilled liquids shall be prevented. Drip pans shall be placed underneath pig trap doors, engine driven equipment, drains and other places of possible liquid spillage to collect liquids which may cause contamination.

The unsafe release of toxic, flammable and explosive gas mixtures shall be prevented by providing facilities for safe venting or disposal as appropriate.

- (S) Noise emission levels shall be kept as low as practical by the selection of appropriate equipment and providing attenuation measures such as noise absorbing barriers and silencers. Maximum permissible levels for safe working and as specified in the scope of work shall not be exceeded.

Direct disposal of water to the environment shall only follow filtering/separation, neutralisation, and confirmation of environmental acceptability of the effluent.

- (A) The location of the precommissioning work site(s) and the arrangement of the equipment (including water supply and disposal sites and facilities) shall be approved by the Principal.

The Contractor shall prepare an emergency plan which defines the actions, personnel and facilities required in case of an emergency. The plan shall address at least the following aspects:

- handling of spillages and other incidents;
- requirements for personnel and equipment;
- requirements for informing others;
- first aid and medical facilities;
- telephone numbers of stand-by crews;
- telephone numbers of police, medical and other authorities to be contacted;
- telephone number(s) of the contact(s) of the Principal.

4. EQUIPMENT

4.1 PRESSURE RETAINING EQUIPMENT

All pressure retaining precommissioning equipment shall be designed, fabricated, tested and marked, in accordance with recognised standards, for a safe operating pressure of not less than the maximum pressure predicted during the precommissioning. Certificates, approved by an independent certifying authority, specifying the applicable standard(s), confirming compliance with these standard(s) and the hydrostatic pressure test data, shall be provided with all such equipment. The certificates shall be available at the work site(s) at all times.

4.2 FILTERS, PUMPS AND COMPRESSORS

Pumps and compressors shall be supplied with test performance data sheets.

- (S) Maximum delivery pressures of pumps and compressors shall not at any time exceed the MAOP of the pipeline and of the precommissioning equipment, including allowances required for transient pressures e.g. due to surges and static head effects. Pumps and compressors shall be fitted with dedicated over-pressure protection devices if the pressure exceeds the maximum allowable pressure. 50 micrometre water filters, or a size specified in the scope of work, with a capacity sufficient for required flowrates shall be provided. Arrangements for filter cleaning without interruption should be available.

4.3 TEMPORARY PIG TRAPS

- (S) Temporary pig traps shall be provided with a major barrel capable of storing at least three pigs, unless otherwise specified in the scope of work. They shall be connected to the pipeline by flanging to permanent pipeline flanges, or by welding.

4.4 WELDING OF TEMPORARY EQUIPMENT

Requirements for the welding of temporary pig traps to the pipeline are:

- welds which have not been subject to the hydrostatic pressure test of the pipeline shall be treated as "golden welds";
- the minimum wall thickness of the temporary equipment shall be not less than 4.8 mm and the ratio between pipeline and equipment wall thickness should not exceed 1.5;
- existing weld metal and the heat affected zone shall be removed by cut-back for at least 12 mm;
- the full circumference of the prepared weld ends of the pipeline and the pig trap shall be ultrasonically tested to confirm the absence of laminations, over a minimum distance of 25 mm from the bevelled ends;
- welding shall be carried out in accordance with DEP 61.40.20.30-Gen.

4.5 FLEXIBLE HOSES

Flexible hoses may be used only for short length connections such as those required to pig traps and instruments. They shall be of the armoured type and be manufactured and tested to recognised standards applicable to permanent hydraulic installations. All hoses and connections shall be of one type. Prior to each re-use, all hoses and connections shall be visually inspected for damage. Damaged hoses shall be marked accordingly and shall not be used. Hoses shall be protected against external damage and be anchored adequately to prevent jumping due to pressure and/or flow variations.

4.6 ELECTRICAL INSTALLATIONS

Electrical installations shall comply with the requirements for temporary equipment as given in DEP 33.64.10.10-Gen.

NOTE: Particular attention is drawn to the use of electrical equipment in hazardous areas.

Equipment shall be earthed for protection against lightning and accumulation of static electricity. Earth jumper leads should be bonded to equipment before hoses and piping are

connected. Hoses and piping should be disconnected and retrieved only with the earth jumper leads connected to equipment.

4.7 DIESEL ENGINES

If diesel engines are used in hazardous areas, consideration of the protection of such engines are required. No such engines should be used in, or within 15 metres of, a zone 1 area. Their use in a zone 2 area should be avoided wherever possible. If the use of diesel engines within 15 metres of a zone 1 or 2 area, or within a zone 2 area, is unavoidable the following shall apply:

- Surface temperature limitation to 250 °C or to the specified temperature class.
- Exhaust flame trap and spark arrestor.
- Non-electric starting system.
- An inlet air shut-down control system to operate on high temperature, overspeed and gas detection.
- Cooling fan blades should be non-metallic and all fan belts antistatic fire resistant type.
- Any ancillary electrical equipment shall comply with DEP 33.64.10.10-Gen.

4.8 TEST CABIN

Test cabins should be air-conditioned or heated, as appropriate, for continuous monitoring and recording, and shall be fully equipped and tested prior to mobilisation to the work site(s). Flexible hoses shall not be allowed inside the test cabin.

4.9 INSTRUMENTATION

All instruments and cabling shall have current certificates of calibration from a recognised certifying authority or third party approved by the Principal. Calibration certificates shall not be older than 6 months at commencement of work at the work site.

Reading divisions, ranges and accuracies of instruments shall be in accordance with Table 1.

Table 1 Reading division, range and accuracy of Instrumentation

INSTRUMENTATION	READING DIVISION	RANGE	ACCURACY
DEWATERING, CONDITIONING, PRESERVATION AND PIGGING			
Flowmeter and recorder	m ³ /h	(Note 1)	± 2% (Note 7)
Pressure gauge and recorder	0.5 bar 1 bar	0 to 16 bar 0 to 60 bar	± 0.6% (Note 6)
HIGH VELOCITY WATER, AIR OR GAS CLEANING			
Flowmeter and recorder for liquids for other media	m ³ /h	(Note 1)	± 2% ± 5% (Note 7)
Pressure gauge and recorder	0.5 bar 1 bar	0 to 16 bar 0 to 60 bar	± 0.6% (Note 6)
METHANOL OR GLYCOL SWABBING			
Density meter	kg/m ³	(Note 2)	± 1% (Note 7)
DRYING WITH DRY AIR, DRY GAS AND VACUUM AND/OR FOR PRESERVATION			
Dewpoint meter	1.0 °C	+ 40 to -50 °C	± 1.0 °C
Ambient air temperature recorder (24 hours)	0.5 °C	0 to 80 °C	± 1% (Note 7)
Temperature probes (digital)	0.1 °C	+ 20 to -50 °C 0 to 50 °C	± 0.2 °C
Pressure gauge and recorder	0.5 bar	0 to 10 bar	± 1% (Note 7)
Flowmeter and recorder	m ³ /h	(Note 3)	± 2% (Note 7)
VACUUM DRYING			
Barometer	1 mbar	(Note 4)	± 0.8 mbar
Pressure gauge and recorder 1	20 mbar	0 to 1000 mbar	± 1% (Note 6)
Pressure gauge and recorder 2	1 mbar	0 to 100 mbar	± 1% (Note 6)
Pressure gauge and recorder 3	0.5 mbar	0 to 50 mbar	± 1% (Note 6)
Pressure gauge and recorder 4	0.1 mbar	0 to 10 mbar	± 1% (Note 6)
Flowmeter	m ³ /h	(Note 5)	± 2% (Note 7)

- NOTES:
- 1) Depending on the flowmeter size (pipeline diameter).
 - 2) Depending on the drying medium to be used.
 - 3) Depending on the pipeline diameter and/or air drying unit capacity.
 - 4) Depending on site altitude.
 - 5) Depending on the vacuum plant capacity.
 - 6) Percentage of measured value.
 - 7) Percentage of the full range.

5. PIGGING REQUIREMENTS

5.1 GENERAL

Pigging operations shall comply with the requirements of this section and with the activity specific requirements specified in sections (6) to (9) and in Appendix A.

5.2 PIG SELECTION

Cleaning pigs with steel brushes or brush coated foam pigs should be used in uncoated carbon steel pipelines. Only polyurethane plates, disc pigs, spiral wound or criss-cross polyurethane coated foam pigs shall be used for cleaning of GRP/GRE pipelines or internally flowcoated pipelines.

- (S) Pigs shall be suitable to pass through pipelines with minimum bore and minimum bend radius as specified in the scope of work.

Foam pigs shall be oversized as required for their duty.

NOTES: 1) Bare foam pigs used for drying have a typical oversize of 10% of the nominal line ID.
2) Bare foam pigs should be replaced by brush or abrasive coated foam pigs if inspection after pigging reveals pig deterioration to the extent that they may disintegrate during pigging and/or become inefficient for dewatering.

The discs on disc pigs shall meet the following requirements:

- the hardness of support/guide discs should be 80 to 90 Shore (A) and their diameter should be marginally larger than the nominal ID of the pipeline;
- the hardness of sealing discs should be 65 to 75 Shore (A) and their diameter should equal the nominal OD of the pipeline.

The use of sealing or solid gels may be considered when pigging pipelines longer than 400 km or with ID variations in excess of 15% of the smallest diameter.

- (A) Sealing or solid gels shall be compatible with the media used during precommissioning and not cause contamination of the fluid during operations. Contractor shall specify and submit all details of the gel, including composition, compatibility, quantities, stability, minimum and maximum pigging speed and impact on driving pressure to the Principal for approval prior to their use.

5.3 PLANNING PIGGING OPERATIONS

Pipeline elevation, density of fluid in the pipeline and back-pressure at the receiving end shall be taken into account when calculating the required inlet flows and pressures for the driving medium.

The control of the pig travelling speed shall be assisted by maintaining a back-pressure of 1 bar (ga) for liquids and 3 bar (ga) for other media above the ambient pressure at the receiving end. This pressure shall be increased where necessary to avoid acceleration of the pig in downhill sections. In case of liquids, the pressure of the receiving end shall always be equal to or in excess of the static pressure that can occur behind the pig during pigging operation.

Single pigs or pig trains shall be separated over distances which provide sufficient time for unloading of receivers without reducing the travelling speed of following pigs or pig trains. Pig trains shall be split if they contain more pigs than the receiver can hold without unloading.

The distance between pigs in a train shall be at least 2% of the pipeline length, with a minimum distance of 150 metres when separated by liquids and 300 metres when separated by other media.

Prior to any pigging operations the Contractor shall verify that:

- all valves have been correctly positioned and are functioning. All main line valves shall be in the fully open position; and
- discharge and/or storage facilities have been connected and are in good working order.

Pigs should be removed from the pig receiver immediately upon arrival, and then inspected.

5.4 PIG TRAIN MONITORING

During all pigging operations the location of the pig trains should be predicted by calculations and measurement of the volume of the driving medium. Launching and arrival of pigs at pig traps should be monitored by pig signallers fitted to the pig traps or by measuring signals from pig location devices fitted to the last pig of the pig train.

When glycol or other chemicals are part of the pig train or used as the driving medium, the location of pig trains should be monitored during the pigging operations. Location monitoring should be done by measuring the signals from pig location devices or by predictions based on the volumes of the discharged fluids measured in the discharge pipe work.

Pig location devices should be of the magnetic, radio or ultrasonic type for pipelines on land, and for offshore pipelines if not liquid filled. Acoustic pinger type pig location devices should be used only for liquid filled offshore pipelines.

5.5 DISLODGING STUCK PIGS

Attempts to dislodge pigs shall be aborted before applied pressures exceed either MAOP of the pipeline/precommissioning equipment or the predicted pigging operation pressure by:

- 50% for lines filled completely with liquids; or
- 5 bar (ga) for all other media.

- (A) The Contractor shall advise the Principal when higher pressures are required to dislodge pigs and shall proceed in accordance with the contingency procedure(s) only after approval by the Principal.

5.6 PIGGING RECORDS

All pigging operations shall be recorded in a pig data register with the following data as a minimum:

- number of the pig run;
- type(s) of pig;
- volumes and pressures of the driving media;
- time of launching and receiving;
- condition of pigs before launching and upon arrival; and
- volume(s) and nature(s) of material and substances arriving in front of the pig at the receiving end.

6. DEWATERING

6.1 GENERAL

- (S) The Contractor shall dewater the pipeline with the medium specified by the Principal in the scope of work.

Final water cleaning may be combined with the first dewatering run. The Contractor shall perform final water cleaning, see (7.2) or (7.3), before or in combination with the first dewatering run if required.

- (S) Only high sealing disc pigs with at least two guiding and four sealing discs should be used unless otherwise specified in the scope of work,
- (S) Sleeping pigs shall be recovered by the Contractor. These pigs shall be used for the dewatering only if specified in the scope of work.

The Contractor shall drain remaining free water in all accessible valve body cavities and dead ends of piping. The method and timing of draining shall be specified in the dewatering procedure of the precommissioning plan.

Dewatering of the pipeline by gravity alone is not permitted.

6.2 DEWATERING RUNS

All pipelines should be dewatered by at least two high sealing pigs.

One run shall be required (6.2.1) as a minimum when the driving medium is:

- nitrogen, glycol or methanol;
- nitrogen in combination with glycol swabbing.

Two runs shall be required, (6.2.1) and (6.2.2), as a minimum when the driving medium is:

- air;
- air in combination with glycol swabbing.

6.2.1 First dewatering run

The first dewatering run shall be carried out as follows:

- the travelling speed of the pig train shall be constant and within the range of 0.5 to 1.0 m/s;
- the internal pipeline pressure shall be kept at least 1 bar (ga) above the ambient pressure at any point along the pipeline by control of back-pressure at the discharge end;
- when dewatering with air or nitrogen only, pigs shall be separated as specified in (5.3);
- when dewatering with methanol or glycol only, pigs shall be separated by a volume of the driving medium to be determined in accordance with (8.5.1).

A typical dewatering pig train driven by air is shown in Figure 2.

Fresh water swabbing shall be performed if salt water was introduced into the pipeline for hydrostatic pressure testing or precommissioning and final air cleaning or drying is required. The requirements for fresh water swabbing are:

- fresh water, of about 4% of the pipeline volume, shall be driven through the pipeline in batches contained by pigs;
- the volume of fresh water between two pigs shall be determined in accordance with (8.5.1);
- the travelling speed and internal pipeline pressure shall be as specified above.

A typical pig train in combination with fresh water swabbing driven with air is shown in Figure 3.

If the fresh water batches are driven by air, swabbing shall repeated until the salt content of a received batch is less than 200 mg per kg of water. If the driving medium is glycol or methanol, or is followed by glycol swabbing fresh water, swabbing should be stopped once the specified volume of fresh water has been pigged through the pipeline.

6.2.2 Second dewatering run

A pig train with one high sealing disc pig, followed by at least by two foam pigs with a density of 80 kg/m³, shall be driven by air through the pipeline as follows:

- the dewpoint of the air for pigging shall be at least 5 °C below the minimum ambient temperature along the pipeline measured at 1 bar (ga);
- the travelling speed of the pigs should be between 0.5 and 1.0 m/s, but shall not exceed 1.5 m/s;
- pigs shall be separated in accordance with (5.3).

Pigging with foam or brush foam pigs shall continue until they arrive without free water in front.

6.3 DEWATERING RECORDS

The Contractor shall measure and record the following:

- details of test water and other media disposed from the receiving end;
- salt content of the last fresh water batch at the receiving end, if applicable;
- for each dewatering run the quantities, pressure and flowrate records of the driving medium;
- for the second run the dewpoint records of the air.

7. FINAL CLEANING

7.1 INTRODUCTION

- (S) The Contractor shall adopt the method for final cleaning as specified by the Principal in the scope of work.

Final water cleaning shall be carried out before or in combination with the first dewatering run.

Low velocity air cleaning shall be carried out in combination with dry air pigging (8.2.2). High velocity air cleaning should be carried out only after the pipeline has been fully dried in accordance with (8.2) or (8.3).

7.2 LOW VELOCITY WATER CLEANING

Low velocity water cleaning shall be carried out by pigging the pipeline with pig trains consisting of a series of brush cleaning pigs followed by a high sealing disc pig, as follows:

- clean and filtered water shall be used as driving medium;
- high sealing disc pigs should be run with open bypass ports of approximately 8% of the pipeline bore;
- the pig travelling speed shall be within the range 0.5 to 1.0 m/s.

Pigging shall continue until two consecutive pigs, the last brush pig and the high sealing disc pig of the train arrive without debris and no debris has been sampled at the discharge end during the run. Final cleaning of carbon steel pipelines shall be concluded by a run with a magnetic cleaning pig.

7.3 HIGH VELOCITY WATER CLEANING

High velocity water cleaning shall be carried out by continuously pumping water at high velocities through the pipeline, as follows:

- clean and filtered water shall be pumped continuously through the pipeline at a minimum velocity of 3 m/s;
- the minimum volume to be pumped through the line shall be three times the volume of the pipeline.

Cleaning shall be considered complete when no debris is sampled at the discharge end whilst replacing the line content at the specified velocity.

- NOTES: 1) The maximum acceptable disposal rates for the hydrotest water may conflict with the specified minimum water velocities for high velocity cleaning. In such cases, the hydrotest water shall first be replaced by clean and filtered water followed immediately by high velocity water cleaning.
- 2) High velocity water cleaning may dictate the required filter capacity.

7.4 LOW VELOCITY AIR CLEANING

Low velocity air cleaning shall be carried in combination with dry air pigging. Pig trains consisting of a series of brush cleaning pigs of brush or brush coated foam pigs followed by a high sealing disc pig shall be driven through the pipeline, as follows:

- high sealing disc pigs should be run with open bypass ports of approximately 5% of the pipeline bore;
- the pig travelling speeds should be within 0.5 to 1.0 m/s;
- the dewpoint of the air shall be as for drying.

Pigging shall continue until two consecutive pigs, the last brush pig and the high sealing disc pig of a train arrive without debris and no debris has been sampled at the discharge end during the run. Final cleaning of carbon steel pipelines shall be concluded by a run with a magnetic cleaning pig.

7.5 HIGH VELOCITY AIR CLEANING

High velocity air cleaning shall be carried out after dry air or vacuum drying. Dry air shall be purged continuously through the pipeline as follows:

- the dewpoint of the dry air shall be as specified for the dry pipeline;
- a minimum air velocity of 10 m/s shall be maintained in the pipeline at the inlet;
- the quantity of air to be used for purging shall be sufficient to replace the volume of the pipeline three (3) times at the purging pressure.

Cleaning shall be complete when no debris is sampled at the discharge end whilst the line content is replaced at the specified velocity.

7.6 FINAL CLEANING RECORDS

The Contractor shall measure and record the following:

- total volume, pressure and flowrate of cleaning medium for each cleaning step;
- quantities and nature of materials received at the end of the pipeline;
- details of media disposed from the receiving end;
- for air cleaning the dewpoint records of the air from both ends of the pipeline.

8. DRYING

8.1 INTRODUCTION

- (S) The Contractor shall adopt the method for drying and achieve the dryness as specified in the scope of work. The general requirements for drying are:
- dry air, nitrogen or vacuum drying shall commence immediately after completion of the second dewatering run;
 - the second dewatering run shall be repeated if drying of the pipeline has not commenced within 48 hours of completion of the dewatering activity;
 - valve body cavities and dead ends of piping shall be dried in compliance with the method and timing defined in the precommissioning plan;
 - the sizing of the drying equipment and calculations of the time required for drying shall be based on a film thickness of the residual water of not less than 0.1 mm for internally uncoated pipes and not less than 0.05 mm for internally coated pipes. Lower values may be assumed if the Contractor can demonstrate, to the Principal's satisfaction, their validity from previous experience.

8.2 DRY AIR AND NITROGEN DRYING

8.2.1 General

- (S) The drying medium to be used shall be as specified in the scope of work. Dry air or nitrogen drying shall be executed consecutively in the following phases:
- pigging;
 - purging for drying; and
 - purging for acceptance testing.

- (S) Air introduced into the pipeline during dry air drying shall have a dewpoint of at least 15 °C below the final dewpoint of the pipeline as specified in the scope of work.

Nitrogen used during drying shall have a dewpoint of below -50 °C at atmospheric pressure.

8.2.2 Pigging

The pipeline shall be pigged with high sealing disc pigs driven by dry air or nitrogen in combination with water absorbing foam pigs with a density between 30 to 50 kg/m³ as follows:

- the travelling speed of the foam pigs should not exceed 1.2 m/s;
- a back-pressure of at least 0.5 bar (ga) shall be maintained at the receiving end; and
- pigs in a pig train should be separated by at least 300 linear pipeline metres.

Pigging shall continue until the dewpoint of the drying medium at the receiving end remains below the dewpoint specified in the scope of work and does not fluctuate by more than 3 °C whilst replacing the content of the line by a pig.

NOTE: The required numbers of foam pigs are typically one per 0.8 km for flowcoated pipelines and one per 1.2 km for pipelines without flowcoating.

8.2.3 Purging for drying

After pigging, the pipeline should be purged with the drying medium with a minimum velocity of 3 m/s in the pipeline at the discharge end. Purging shall continue until the dewpoint at the discharge end remains below the specified dewpoint whilst replacing twice the content of the pipeline at purging pressure.

8.2.4 Purging for acceptance testing

Upon completion of purging, the pipeline shall be blocked-in for a period of at least 12 hours and at a pressure of 0.5 bar (ga) above the ambient pressure at all points along the pipeline. After this period the pipeline content shall be replaced at the lowest possible pressure and the dewpoint continuously measured at the discharge end.

Drying is complete when the dewpoint during acceptance purging remains below the final

dewpoint specified for the pipeline whilst replacing the line content. Purging for drying shall recommence and the acceptance test shall be repeated until this requirement has been met.

Upon completion of the drying, the pipeline shall be blocked in at a pressure of 0.5 bar (ga) above the ambient pressure at any point along the pipeline.

8.3 VACUUM DRYING

8.3.1 General

- (S) Water vapour shall be evacuated from the pipeline by vacuum units alone or in combination with dry air or dry nitrogen vacuum purging as specified in the scope of work. The final dewpoint of the dry pipeline shall be -20°C , which is equivalent to a pressure of 1 mbar (abs), unless otherwise specified in the scope of work.

Vacuum drying should consist of the following stages unless otherwise approved by the Principal:

- pre-drying checks;
- leak test(s);
- pump-down;
- evaporation/evacuation, including vacuum purging;
- soak test/acceptance test;
- filling phase.

A typical pressure time plot of the various vacuum drying phases is given in Figure 5.

The size of the vacuum unit(s) should be sufficient to reduce the pressure in the pipeline to the vaporisation pressure during pump-down within 36 hours of commencement of the pump-down operation.

The Contractor shall prepare a theoretical pressure/time graph for each of the drying phases, which shall be included in the precommissioning plan.

8.3.2 Pre-drying checks

Before commencement of vacuum drying the Contractor shall verify that:

- the pipeline has been isolated from other pipelines and pipework;
- valves are designed for vacuum drying and have been placed in to the half open position;
- valve body bleeder parts are vacuum tight;
- temporary connections, pig trap valves and pig trap end closure have vacuum tight seals.

8.3.3 Leak test(s)

The pipework connecting the vacuum unit with the pipeline, including pig trap(s) and vacuum unit(s), shall be isolated from the pipeline and the pressure in the isolated pipework lowered to slightly above the theoretical evaporation pressure.

NOTE: For dry pipework a typical leak test pressure of 8 to 10 mbar (abs) should be applied.

The vacuum unit shall be switched off and the isolated pipework checked for leaks by visual/audio inspection. Leaks shall be cured by either flange tightening, taping flange circumferences, taping grease nipples and applying plasticine or equivalent to valve stems.

The pipeline shall then be opened to the vacuum unit(s) and the pressure in the entire system reduced to a pressure of 50 to 100 mbar (abs) for the final leak test. The pressure shall be maintained at this level and all other piping, such as at inline block valve stations and the pig trap system of the other end of the pipeline if vacuum drying is carried out from one end only, shall be checked for leaks. Leaks shall be cured as stated above.

After all leaks have been cured, where possible, the vacuum unit shall be turned off and isolated from the pipeline and the pressure in the pipeline and the associated pipework monitored for at least one hour. Pressure increases shall be recorded and plotted on a pressure/time chart. From the measured pressure increase, the total leak rate shall

calculated. Curing of leaks shall be continue until the calculated total leak rate is less then 10% of evacuation capacity of the vacuum units at the initial leak test pressure.

8.3.4 Pump-down

The pressure in the pipeline shall then be reduced to the level predicted for the evaporation of the residual water. The pressure shall be kept at this level and pig traps and piping inspected for vacuum tightness and leaks cured.

8.3.5 Evaporation/evacuation

The vaporisation pressure shall be maintained and water vapour evacuated by pumping until all residual water has evaporated.

Ice formation in the pipeline and associated fittings shall be avoided by control of the evacuation rate through the vacuum units.

NOTE: The temperature of the water vapour drawn from the pipeline should remain above +3 °C at atmospheric pressure.

Vaporisation and evacuation by pumping shall continue until the vapour pressure has reached the level that is equivalent to the dewpoint specified for the dry pipeline in (8.3.1). This pressure shall be maintained for at least 3 hours to confirm that a stable balanced vacuum pressure is established throughout the pipeline. Evacuation shall then be stopped and a soak test carried out in accordance with (8.3.6).

Vacuum purging with dry air or nitrogen at pressures in the range of 3 - 10 mbar (abs) may be applied in addition to evacuation by pumping to reduce the time needed for conventional evaporation and water vapour evacuation. If applied, purging and evacuation shall continue until the dewpoint at the vacuum unit is constantly below the dewpoint for a dry pipeline specified in the scope of work while replacing at least twice the contents of the pipeline. Purging shall then be stopped, the pressure reduced to 3 mbar (abs) and maintained at this level for at least 3 hours to achieve stable conditions in the pipeline. A Soak Test in accordance with (8.3.6) shall then be performed.

NOTE: This method does not require a further reduction of the vacuum pressure.

8.3.6 Soak test/acceptance test

The pipeline shall be blocked in and isolated from all equipment other than that required for pressure monitoring for a period of at least 24 hours, at a pressure of:

- 1 mbar (abs) in case of vapour evacuation by pumping only;
- 3 mbar (abs) in case of vapour evacuation by pumping and purging;

or as specified in the scope of work, see (8.3.1).

Drying is complete when observed pressure increases can be accounted for from the leaks measured during the pipeline leak test (8.3.3).

8.3.7 Filling phase

- (S) Upon successful soak test, the Contractor shall fill the pipeline with either dry air or dry nitrogen as specified in the scope of work, to:

- 50 mbar (abs), for nitrogen.
- 500 mbar (ga) above the ambient pressure at any point along the pipeline, for dry air.

NOTE: Section (9.2) specifies the requirements for preservation.

Warning signs such as "PIPELINE UNDER VACUUM" or "PIPELINE FILLED WITH DRY AIR" shall be placed at all affected pipework, including block valve stations and pig trap systems.

8.4 DRY AIR PIGGING IN COMBINATION WITH VACUUM DRYING

Dry air pigging followed by vacuum drying shall be carried out after completion of the second dewatering phase, as follows:

- (S) - the dewpoint of the dry air shall be -40 °C unless otherwise specified in the scope of work.
- dry air pigging shall be performed in accordance with (8.2.2), and shall be continued until the dewpoint of the air received is -15 °C at atmospheric pressure and remains at this level whilst the line content is replaced by a dry air driven pig;
- after completion of dry air pigging, vacuum drying in combination with dry air vacuum purging in compliance with (8.3) shall follow.

8.5 GLYCOL SWABBING

8.5.1 General

The driving medium for glycol swabbing shall be either dry air or nitrogen, as specified for dewatering in (6.1).

The glycol shall be pigged in batches through the pipeline. The volume of each batch contained between two pigs shall be calculated from the equation:

Volume	=	$f \times D \times L$	(m ³)
where: D	=	Internal diameter of the pipeline	(m)
L	=	Length of the pipeline	(km)
f	=	Factor for pigging	(m ² /km)
		(for uncoated pipelines	f = 0.7)
		(for coated pipelines	f = 0.5)

The calculated batch volume shall be increased if necessary to achieve a minimum batch length of 25 linear pipeline metres.

8.5.2 Glycol swabbing with dry nitrogen

Glycol swabbing with dry nitrogen should be combined with the first dewatering run (6.2.1). Three pigs containing two glycol batches of a volume determined in accordance with (8.5.1) should be used.

8.5.3 Glycol swabbing with dry air

Glycol swabbing with dry air shall be carried out after completion of the first dewatering run, as follows:

- three pigs containing two glycol batches of a volume determined in accordance with (8.5.1) should be used;
- the air shall be separated from the glycol by a high sealing disc pig and a volume of nitrogen at atmospheric pressure with a length of at least 2% of the pipeline length but not less than 600 linear pipeline metres;
- the speed of the swabbing train should be between 0.5 and 0.8 m/s and shall not exceed 1.5 m/s;
- glycol samples shall be taken from the discharge end and analysed for water content. A direct-density metering system shall also be used to measure the specific gravity of the samples and determine the content of water. The water content and specific gravity data shall be available within 12 hours of the swabbing train at the discharge end.

A typical glycol swabbing train driven by air is shown in Figure 4.

- (S) Swabbing shall continue until the water content of the glycol is less than the value specified in the scope of work, or 20% if not specified. Swabbing shall be repeated until the maximum allowable water content has been achieved.

8.6 DRYING RECORDS

For each listed activity, the Contractor shall provide records of the following parameters:

Activity	Parameter to be recorded
- pigging with dry air or nitrogen (8.2.2)	dewpoint, temperature, pressure at inlet and outlet of the pipeline, plus flowrate and total volume of drying medium;
- purging for drying (8.2.3)	as specified for (8.2.2);
- purging for acceptance testing (8.2.4)	as specified for (8.2.2), plus nitrogen product certificate, if applicable;
- leak test (8.3.3)	temperature, pressure over time chart, plus acceptance calculations;
- pump-down phase (8.3.4)	temperature, flowrate, total volume evacuated, plus pressure over time chart;
- evacuation phase (8.3.5)	temperature, flowrate, total volume evacuated, plus pressure over time chart;
- purging phase (8.3.5)	as specified for (8.3.5), plus dewpoint at the inlet and outlets of the pipeline;
- soak test (8.3.6)	pressure over time chart, plus acceptance calculations;
- filling phase (8.3.7)	temperature, pressure, temperature and dewpoint of the medium at inlet of the pipeline, plus final pipeline pressure and nitrogen product certificate, if applicable;
- dry air pigging and vacuum drying (8.4)	as specified in (8.2.2) and (8.3.2) to (8.3.7);
- glycol swabbing (8.5)	volume of glycol introduced and received, water content of the glycol received from the pipeline, plus glycol product certificate.

9. CONDITIONING AND PRESERVATION

9.1 CONDITIONING BY INHIBITION

- (S) The Contractor shall condition the pipeline by swabbing slugs of inhibitor liquids contained between pigs through the line, if specified in the scope of work.
- (S) The slug composition, required thickness of the liquid film on the internal pipewall and driving medium shall be as specified in the scope of work.

The requirements for conditioning with liquid slugs are as follows:

- the Contractor shall calculate the volume of liquid required to achieve the specified film thickness. The calculation shall account for the dynamic sealing performance of the pigs and the performance changes due to pig wear;
- the liquid shall be split into three batches separated by four high sealing disc pigs.
- the minimum length of each batch shall be 25 linear pipeline metres.

9.2 PRESERVATION AFTER DRYING

- (S) The Contractor shall increase the pressure in the pipeline with the same medium as specified in (8.3.7).

The requirements for preservation are as follows:

- the final pipeline pressure to be achieved at the end of the filling operation shall be 0.5 bar (ga) above the ambient pressure at any point along the pipeline, plus a margin allowing for the maximum possible ambient temperature fluctuation during the post-precommissioning period;
- the dewpoint; pressure and temperature of the medium introduced into the pipeline shall be measured and recorded constantly at the inlet of the pipeline throughout the filling operation;
- Warning signs such as "PIPELINE FILLED WITH NITROGEN" or "PIPELINE FILLED WITH DRY AIR" shall be provided and placed at block valve stations and pig trap systems.

9.3 CONDITIONING AND PRESERVATION RECORDS

The Contractor shall provide product certificates of the media introduced into the pipeline plus the following parameters as a minimum:

- quantities introduced into and received from the pipeline;
- batch volume and pigging records in accordance with (5.6), if applicable;
- dewpoint, temperature, pressure and flowrates of the medium being used.

10. SCOPE OF WORK CHECKLIST

The scope of work shall specify the data and/or activities summarised herein for precommissioning of the pipeline. An alphanumeric prefix references a section of Appendix A.

Section	Description	Requirement / value
2.1	Commencement of precommissioning Immediately after hydrostatic pressure testing? or immediately prior to commissioning? Specify the date:	Yes ☐ No ☐ Yes ☐ No ☐
2.1	Sequence of precommissioning To be in accordance with this DEP? If no, state the required sequence:	Yes ☐ No ☐
2.1/ 5.2	Pipeline data State the relevant pipeline data: Outside diameter: Nominal wall thickness: Minimum bend radius: Minimum bore: Length: Internal volume: MAOP: Design pressure: Design temperature: Linepipe material: Flowcoating: Pig traps: Block valve stations: If yes, state number:	mmmmmmmmmm ³bar (ga)bar (ga)°C Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐
2.1	Hydrotest water data Are chemicals or a dye added to the line-fill water? If yes, state details:	Yes ☐ No ☐
2.1/ 3	Hazardous area classification Do hazardous areas exist at precommissioning work sites? If yes, state the area classification:	Yes ☐ No ☐ Zone..... Zone..... Zone.....
2.2	Timing of the submission of the precommissioning plan To be in accordance with this DEP? If no, specify the submission time of the plan in advance of the planned date of the first activity at the work site:	Yes ☐ No ☐days

2.4	Precommissioning records and reports Are more than three copies of the final report required? If Yes, state the number of copies: Is the submission date in accordance with DEP? If no, state working days:	Yes ☐ No ☐copies Yes ☐ No ☐days
3.	Gas detection devices & breathing apparatuses Are gas detection devices required? If yes, state the number: Are breathing apparatuses required? If yes, state the number:	Yes ☐ No ☐ Yes ☐ No ☐
3.	Maximum allowable noise level Specify the maximum allowable noise level:	dB (A)
4.2	Filters, pumps and compressors Are filters of 2 micrometres required?	Yes ☐ No ☐
4.3	Temporary pig traps Are other pig traps required? If yes, state number of pigs to be stored and length:	Yes ☐ No ☐pigsm
6.1	Driving medium of dewatering operations Is compressed air the driving medium? If no, specify the medium:	Yes ☐ No ☐
6.1	Dewatering pigs As specified in this DEP? If no, state type:	Yes ☐ No ☐
6.1	Dewatering with sleeping pigs Are sleeping pigs in the pipeline? If yes, state the number of pigs	Yes ☐ No ☐
A6.1	Purity of the fluid Is contamination of the fluid with chlorides acceptable?	Yes ☐ No ☐
A6.1	Duration of the post dewatering period To be in accordance with this DEP? If no, specify the duration:	Yes ☐ No ☐days
7.1	Final cleaning Is final cleaning required? If yes, state selected cleaning process and method: If water cleaning, state velocity: If air cleaning, state velocity:	Yes ☐ No ☐ High ☐ Low ☐ High ☐ Low ☐
8.1/ A8.1	Drying Is drying required? If yes, state the drying process: Dry air or nitrogen drying? Vacuum drying? Combination of drying methods? Methanol or glycol swabbing?	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐
8.2	Dry air or nitrogen drying If yes, state the medium: Is the medium dry air? Is the medium nitrogen? Is the dewpoint in accordance with this DEP? If no, specify:	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐°C

8.3	Vacuum drying	Yes ☐ No ☐
8.3.1	General Is the evaporation/evacuation phase in combination with vacuum purging? If yes, state the medium: Dry air? Dry nitrogen? Are the dewpoint(s) in accordance with the DEP? If no, specify:	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐mbar (abs)
8.3.7	Filling phase Is filling as specified in the DEP? If no, specify the pressure:	Yes ☐ No ☐mbar (abs)
8.4	Dry air pigging in combination with vacuum drying If yes, is the dry air dewpoint in accordance with this DEP? If no, specify:	Yes ☐ No ☐°C
8.5	Glycol swabbing If selected, state: Is the acceptance criterion in accordance with this DEP? If no, specify water content of the drying medium:	Yes ☐ No ☐weight %
9.1	Conditioning by Inhibition Is inhibition required? If yes, state: Film thickness: Type of Inhibitor: Volume: Type of carrier medium: Volume:	Yes ☐ No ☐ mmm ³m ³

11. SUMMARY OF REQUIRED APPROVALS BY THE PRINCIPAL

Section	Activity / Procedure requiring approval
2.2	Precommissioning plan Precommissioning plan
2.4	Precommissioning records and reports Final draft of the "Final Precommissioning Report"
3.	Health, safety and environment Work site location and arrangement of equipment Water supply and disposal locations and facilities
5.2	Pig selection Sealing gel specification and pigging procedure
5.5	Dislodging stuck pigs Removal of stuck pigs from the pipeline

NOTE: There may be additional approvals listed in the scope of work.

12. REFERENCES

In this DEP, reference is made to the following publications:

NOTE: Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.

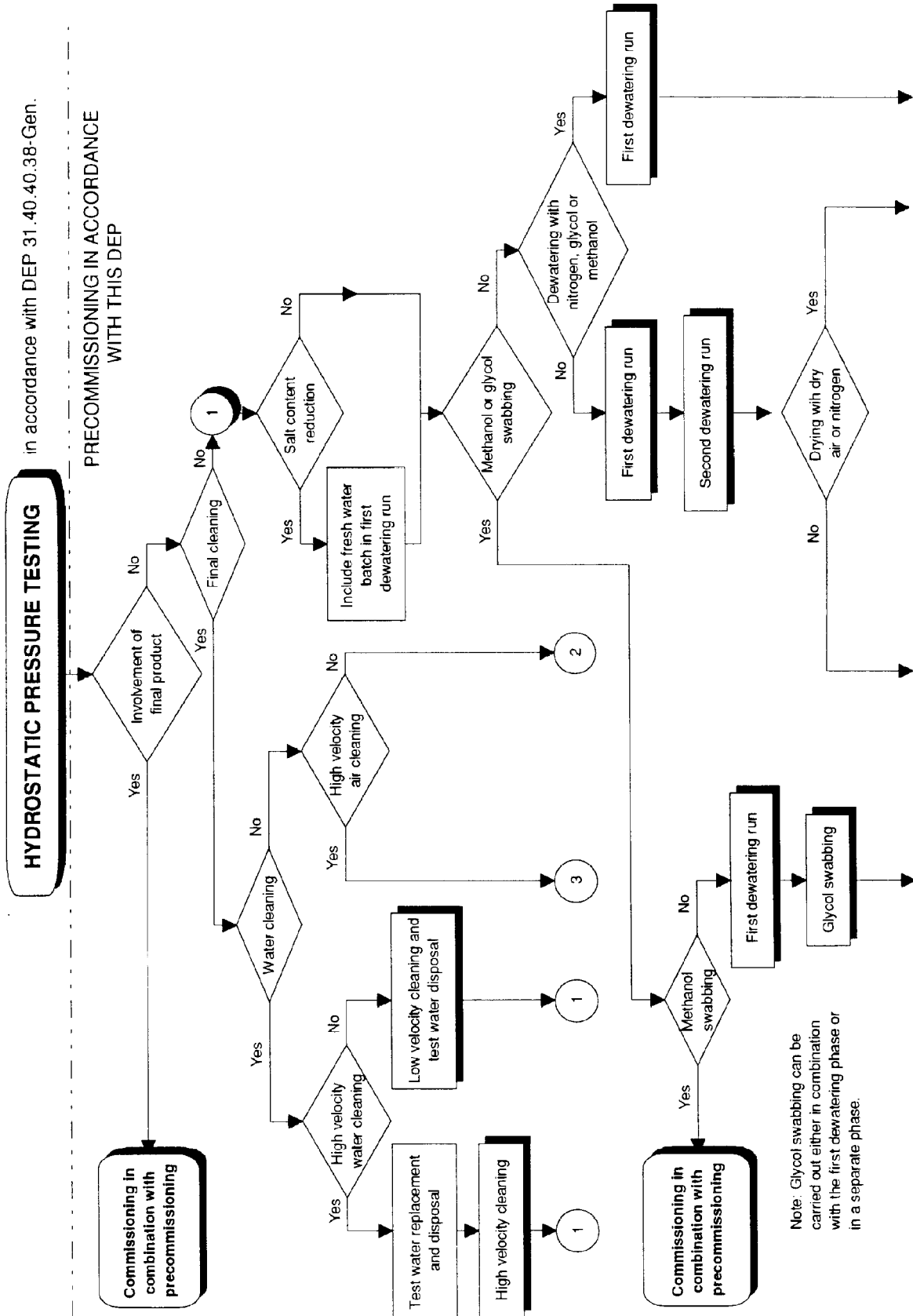
SHELL STANDARDS

Index to DEP publications and standard specifications	DEP 00.00.05.05-Gen.
Welding of metals	DEP 30.10.60.18-Gen.
Hydrostatic pressure testing of new pipelines	DEP 31.40.40.38-Gen.
Electrical engineering guidelines	DEP 33.64.10.10-Gen.
Welding of pipelines and related facilities	DEP 61.40.20.30-Gen.

FIGURES

- FIGURE 1 FLOW CHART FOR PRECOMMISSIONING ACTIVITIES
- FIGURE 2 TYPICAL FIRST DEWATERING RUN DRIVEN BY AIR
- FIGURE 3 TYPICAL FIRST DEWATERING TRAIN FOR PIPELINES CONTAINING SEA-WATER (If drying is specified)
- FIGURE 4 TYPICAL GLYCOL SWABBING TRAIN DRIVEN WITH AIR IN A PIPELINE CONTAINING WET AIR
- FIGURE 5 TYPICAL PRESSURE TIME PLOT OF VACUUM DRYING PHASES

FIGURE 1 FLOW CHART FOR PRECOMMISSIONING ACTIVITIES



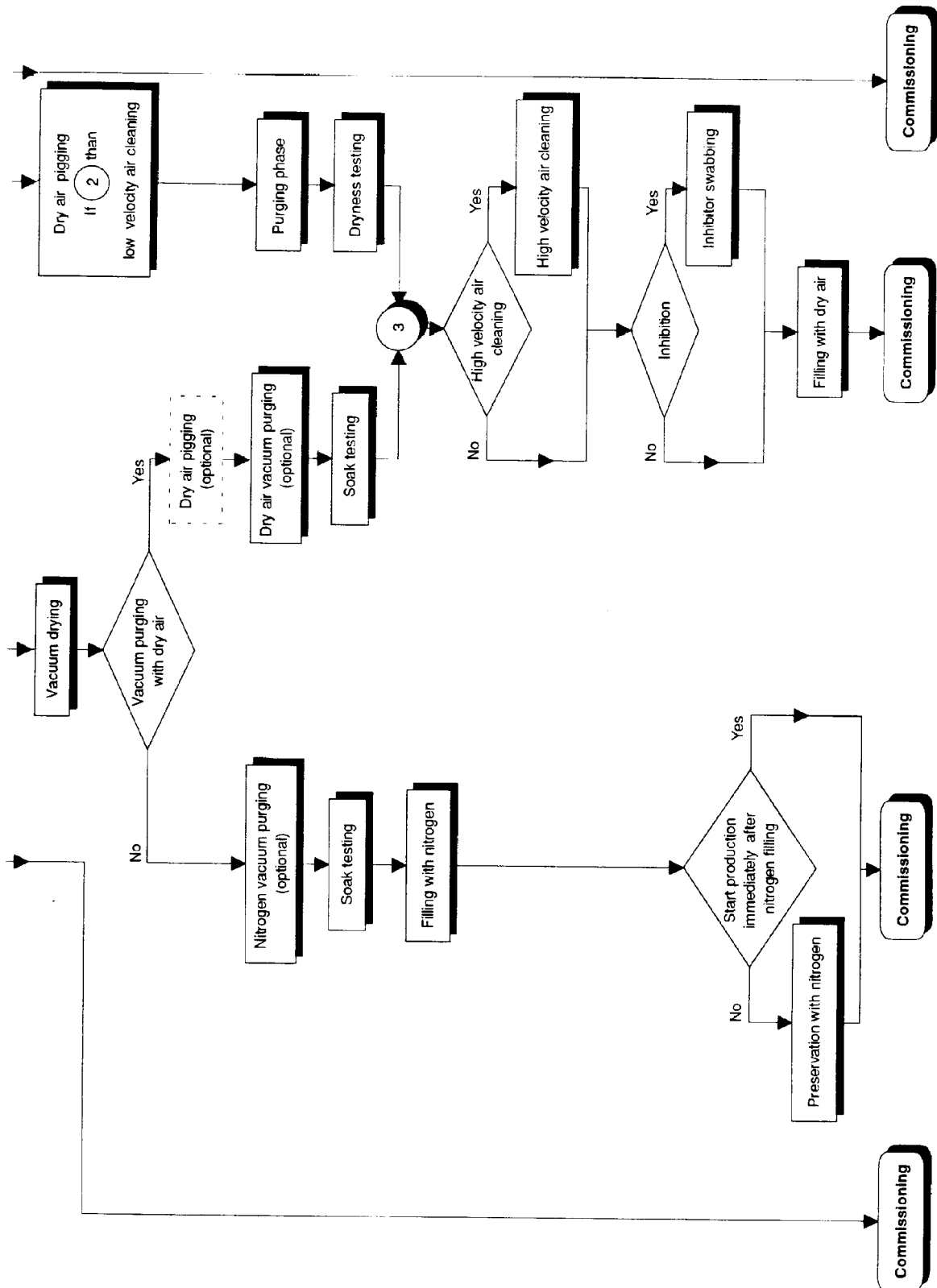


FIGURE 2 TYPICAL FIRST DEWATERING RUN DRIVEN BY AIR

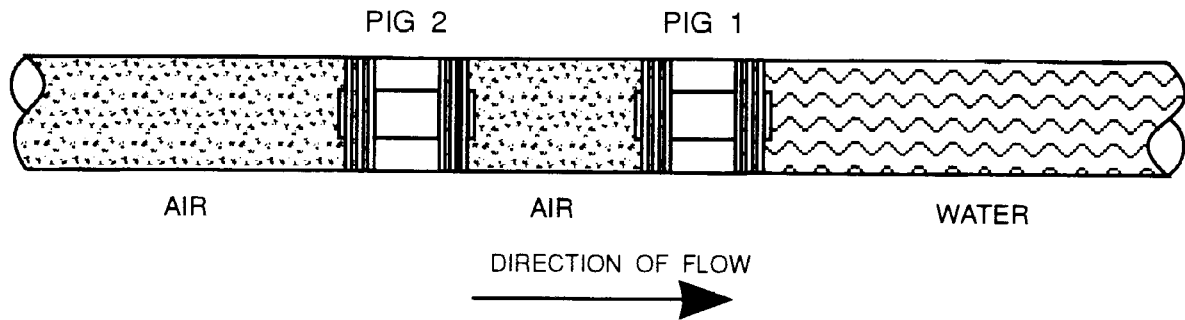


FIGURE 3 TYPICAL FIRST DEWATERING TRAIN FOR PIPELINES CONTAINING SEA-WATER (If drying is specified)

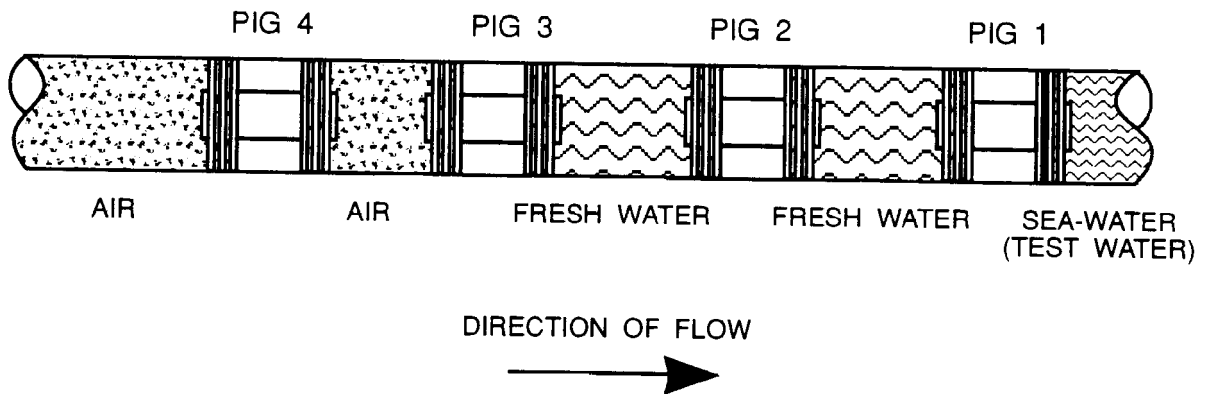


FIGURE 4 TYPICAL GLYCOL SWABBING TRAIN DRIVEN WITH AIR IN A PIPELINE CONTAINING WET AIR

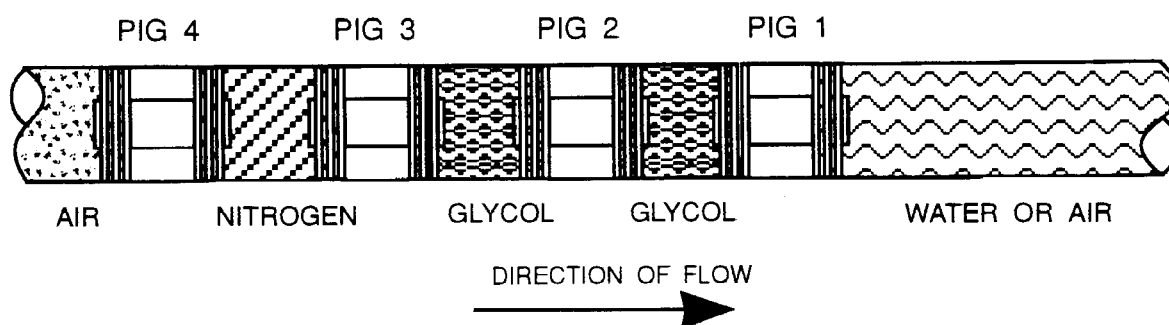
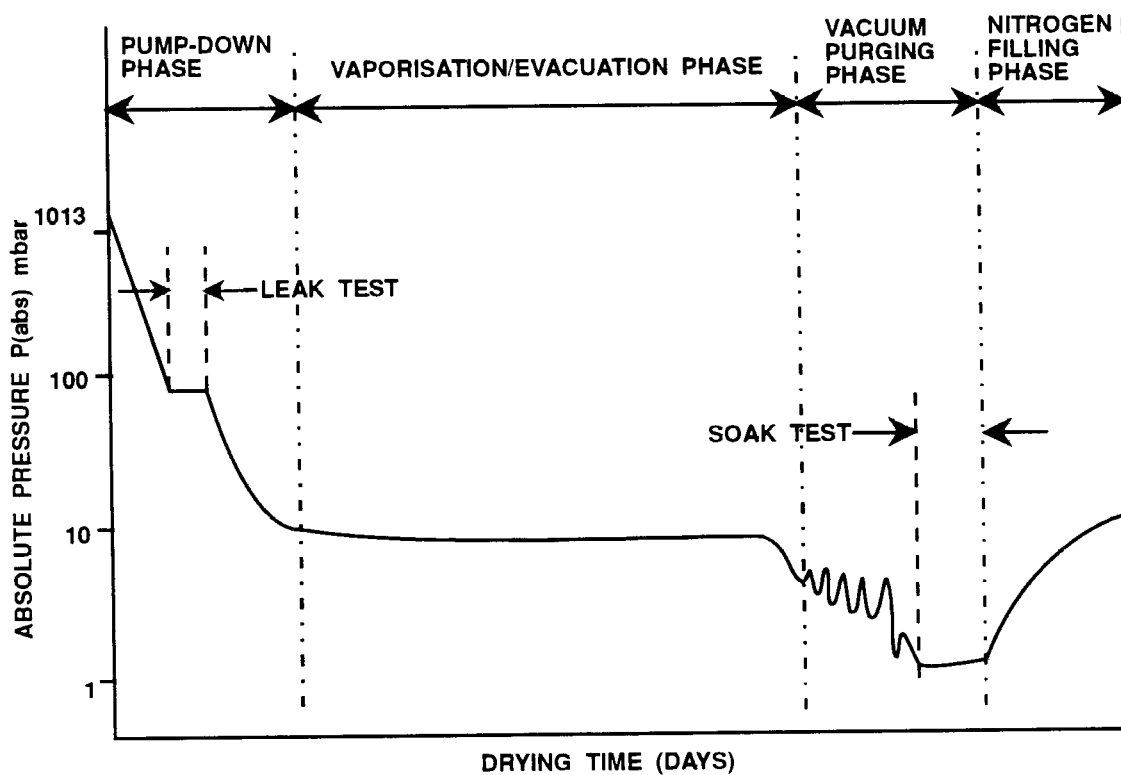


FIGURE 5 TYPICAL PRESSURE TIME PLOT OF VACUUM DRYING PHASES



APPENDIX A STAINLESS STEEL PIPELINES

A1. INTRODUCTION

A1.1 SCOPE

This Appendix specifies additional requirements for the precommissioning of pipelines made of stainless steel, duplex stainless steel or carbon steel with internal stainless steel cladding.

A1.3 DEFINITION

A1.3.1 General definition

The numbering system in this Appendix is designed to allow for easy reference back to the remainder of the DEP by using the numbering system contained therein. Only additional requirements are given in this Appendix.

A2. GENERAL REQUIREMENT

A2.1 BASIC REQUIREMENTS

The Contractor shall avoid contact between stainless steel and all equipment made of carbon steel or other non-compatible materials, with the exception of the temporary pig launcher and receiver as specified in (A4).

If the metal temperature of the pipeline exceeds 50 °C, then only condensed or demineralized water, with a chloride content of maximum 2 mg per kg of water, shall be used.

A4. EQUIPMENT

A4.4 WELDING OF TEMPORARY EQUIPMENT

Only pig traps or components made of stainless steel compatible materials shall be directly connected to the pipeline. Other pig traps or components shall be welded only via "pup" pieces made of compatible material and sufficient lengths to the pipeline.

- (S) Welding shall be carried out in accordance with DEP 30.10.60.18-Gen. or the pipeline construction specification, unless otherwise specified in scope of work.

A5. PIGGING

A5.1 PIG SELECTION

Only high sealing disc pigs should be used for pigging operations.

A6. DEWATERING

A6.1 GENERAL

The dewatering pigs shall be driven by nitrogen or the fluid, whenever practicable. The entrance of air/oxygen into the pipeline shall be avoided during the dewatering.

If the chloride content of the linefill water in the pipeline is greater than 200 mg per kg of water and air is being used as a driving medium, the following requirements shall apply:

- the pipeline shall be flushed or swabbed with slugs of potable water, condensed or demineralized, in combination with the first dewatering run;
- the volume of the water batches swabbed through the line shall be determined as specified in (6.2) for the fresh water;
- flushing or swabbing shall continue uninterrupted until the chloride content of the disposed water has been reduced to below 200 mg per kg of water;
- dewatering shall then continue as specified below.

If the chloride concentration of the linefill water or the residual water in the pipeline is less than 200 mg per kg of water and air is being used as a driving medium, the following requirements shall apply:

- the pipeline shall either be dewatered in accordance with (6.2) and (6.3), as applicable, and immediately dried in accordance with (A8), or
- the pipeline shall be flushed or swabbed with slugs of condensed or demineralized water, with a chloride content of maximum 2 mg per kg of water, until the chloride content of the disposed water and the introduced water is equal;
- dewatering shall continue with a second dewatering run as specified in (6.3).

- (S) The pipeline shall not be left dewatered with air for more than 2 weeks unless otherwise permitted in the scope of work.

NOTE: The required purity of the fluid may dictate further flushing or swabbing with condensed or demineralized water having a chloride content of maximum 2 mg per kg of water.

A7. CLEANING

A7.1 INTRODUCTION

High sealing disc pigs instead of wire brush type cleaning pigs, specified in (7.2.) and (7.4.), should be used. If the use of brush type cleaning pigs is necessary, then only pigs with stainless steel brushes shall be used.

A8. DRYING

A8.1 INTRODUCTION

- (S) The Contractor shall adopt the method for drying and achieve the dryness specified in the scope of work. The general requirements for drying are:

- drying shall follow immediately after dewatering and shall be carried out in accordance with (A8.2) or (A8.3);
- the second dewatering run shall be repeated if drying of the pipeline has not commenced within 36 hours of completion of the dewatering activity;
- valve body cavities and dead ends of piping shall be dried in compliance with the method and timing defined in the precommissioning plan.
- the sizing of the drying equipment and calculations of the time required for drying shall be based on a film thickness of the residual water of not less than 0.05 mm. Lower values may be assumed if the Contractor can demonstrate their validity from previous experience to the Principal's satisfaction ;
- the period between drying and commissioning shall be kept as short as possible.

A8.2 DRY AIR OR NITROGEN DRYING

A8.2.1 General

Only nitrogen shall be used as drying medium.

A8.3 VACUUM DRYING

A8.3.1 General

The size of the vacuum unit(s) should be sufficient to reduce the pressure in the pipeline to the vapourisation pressure during pump-down within 24 hours of commencement of the pump-down operation.

If vacuum purging and line filling is performed with dry air, only super-dry air with a dewpoint below -40 °C shall be introduced into the pipeline.